Accelerator Systems Division Highlights Ending January 14, 2005

ASD/JLAB: Cold Linac

Assembly of the H-12 and H-2 cryomodules continues on schedule.

H-10 was shipped to ORNL.

H-11 will be shipped to ORNL next week.

ASD/BNL: Ring.

We now have full agreement on the characterization of the injection line mock-up assembly, including the injection dump septum magnet and vacuum chamber. The line is being dismantled and the vacuum chambers removed for cleaning and TiN coating. Magnets and stands should be at Oak Ridge by Feb. 1st.

RF quadrupole doublet #1 was shipped on January 11.

Next shipment from BNL will be on Jan 18. It will contain RF quadrupole doublet #2 and the repaired injection septum magnet.

After that (week of Jan 25):

- Injection kicker magnet (short) and stand; wall current monitor (RF); RF power supply; vacuum chambers - 3 Ring and 10 RTBT; PLC for HEBT vacuum controller; balance of BLMs (4 boxes ~ 220 units); LANL motion chassis and cables (one box).
- HEBT Vacuum PLC chassis; ten (10) each IDEC 24 V power supplies for HEBT/Ring/RTBT; marked attention Derrick Williams at SNS/OR.
- Injection line magnets and stands
- Seven (7) electron detectors

BNL received the assembly model of the RTBT rad hard quads (36Q85) from Kerry Potter. Jim Alduino reported that said files uploaded without problems. Work continues between BNL and ASD on vacuum chamber designs between Q26 and the d/s harp vessel.

At the request of SNS/OR, four (4) FBLMs were overnight shipped from BNL.

Welding of the injection dump drift pipes and QH1 chamber is in progress.

The extraction doublet chambers have been vacuum degassed and are ready for TiN coating.

The last two extraction kicker modules have been coated. One of the two kicker assemblies (seven magnets) is nearly complete. Bake-out blankets are starting to arrive from our vendor.

Alpha Magnetics has six coils wound and four potted. They completed a trial assembly of the core, coils and vacuum chamber (see attached photos). Jim Rank will visit Alpha next week for a final as-built inspection. Alpha is on target for 2/1/05 shipment.

RTBT 17D224: Pioneer Steel has completed all machining of the magnet core. They plan to paint and ship next week.

Two 36Q85 quadrupoles have been magnetically measured. Unit #3 is being set-up for measurements. Number four is ready to go.

IPM chambers are being baked-out in prep for TiN coating.

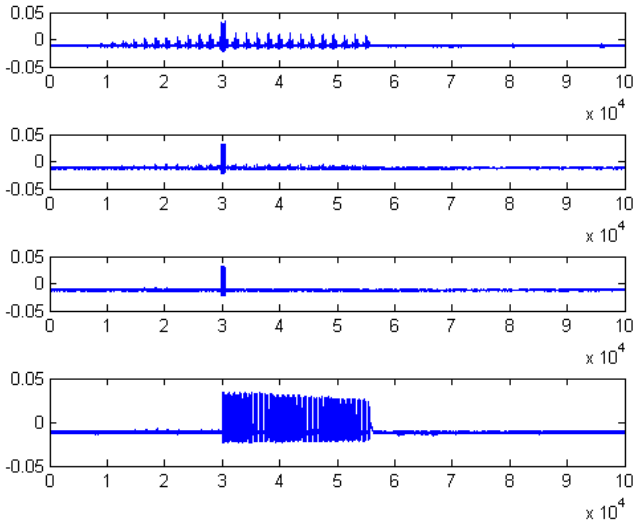
E
Extraction Lambertson septum magnet(17ELS224)

Controls

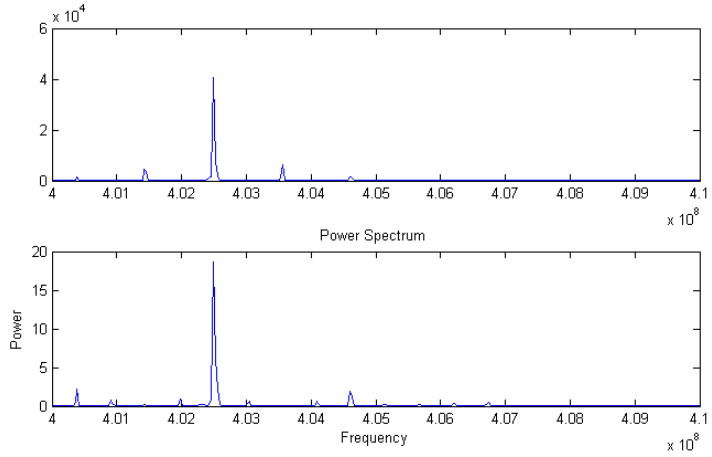
Work continued on preparations for the move to the CLO Control Room (CCR). The console locations were taped, under-floor communications cabling completed and the prototype console was delivered Friday afternoon. It will be installed in the south console arc on Monday afternoon.

After many discouraging attempts in previous weeks, the LEBT chopper was run successfully. Tests resumed after the switches were repaired, the VHDL code was changed to set the delay between plus and minus voltage to 100ns to prevent “shoot through” faults, the minimum pulse width was increased to 295nsec, the threshold for over-current faults was increased and the thresholds for pulse width and repetition rate were decreased. In addition, the ion source was realigned. With those changes, chopper performance improved considerably.

The top three plots below show single turn injection with the LEBT voltage set to 1.5kV, 1.75kV, and 2kV. In previous tests the high voltage had to be set to 2.5kV to get similar results. The bottom trace shows the first 20 usec of beam chopped, then nominal 30% chopping.



The data above was taken with a PC scope at a sample rate of 1GHz. All analog filters were removed from the Beam Current Monitor (BCM) so the micro structure of the beam can be seen. The power spectrum of the beam pulse after the single turn was calculated and is shown below. This indicates an extinction ratio of better than 2000:1 far exceeding the requirement for the LEBT alone of 100:1.



MEBT chopper pulse-train output was added to the LEBT chopper controller prototype and equipment was installed for the upcoming MEBT chopper test run. The preliminary architecture study and design for the next-generation LEBT/MEBT Chopper Controller continued this week.

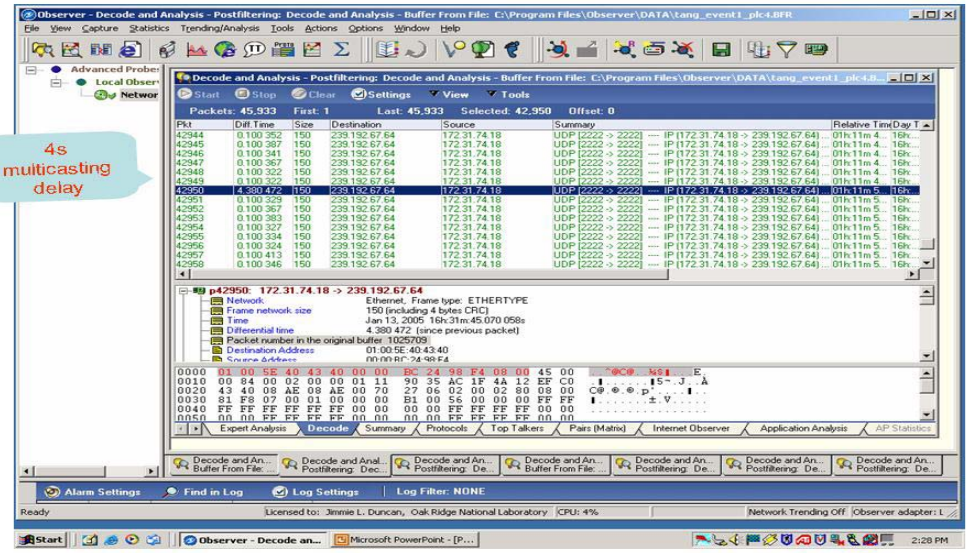
The automated power supply test developed by the controls team is now in use by the power supply group. The result is that, with minor caveats, when the electrical group has completed its testing, the controls group has completed its testing and the power supplies are calibrated to within the requirements of the Physics group. This week Power Supplies QD03 QD04 QD05 QD08 were tested in this manner. Data is saved by archiver automatically and screen snapshots are saved manually.

Fabrication of new racks to support the PPS move to the CLO control room is underway: The fiber/coax repeater rack is completed in the CER and the new rack in Front End has been started. The majority of PPS DB labor field work is completed in the HEBT, and conduit and cabling work has begun in the Ring. A recertification of the phase 1.2 PPS was completed to add the third SCL-RF system to the PPS.

Work to install cable tray and conduit for the instruments has begun in the Beamline 2 area of the target building. The PPS cabling is on site and cable pulls will begin early next month. To facilitate planning of installation of PPS conduit and cabling, a walkdown of the target building was conducted. Transfer cell work will begin as soon as

possible after completing Beamline 2. Design and fabrication activities are continuing for PPS equipment for the target building. The primary shutter I/O cabinet is complete and ready to ship to the installation contractor. Preliminary discussions were held this week with several Instrument Scientists to discuss the integration of the access control features of the Instrument PPS with additional safety functions required due to non-radiation hazards (i.e. vacuum and inert gas).

With the help of the ORNL network group, considerable effort was expended in analyzing a PLC-PLC communication issue that was resulting in loss of heartbeat indications and resultant trips and valve insertions. A



network analyzer was used to capture and analyze millions of packets, including during the anomalous delayed events. It has been learned that for reasons not yet understood, one PLC occasionally stops its usual regular 100ms multicast, although TCP communications continue, indicating it is otherwise in good health. A data snapshot is shown below. Help will be sought from Allan-Bradley to understand the PLC problem. In the meanwhile the heartbeat time-out has been lengthened.

Overall, this was a very successful week for both the cryogenic group and the ICS cryo control group. A faulty application on the cryo server used vast amounts of disk space and caused problems with the archiver. The problem was quickly diagnosed by ICS system experts and the faulty program removed. The cryo server was successfully rebooted and now has 48% free disk space. The archiver is functioning properly.

A new EPICS server is being installed and commissioned for the cryogenic control system. This server provides the capacity and speed required to support controlling and archiving data for the CHL and cryomodules from the CHL control room. All software has been installed on the new server. A test IOC has been successfully booted from the new server using the latest version of EPICS (3.14.7). Extensive testing will be performed prior to shifting all ICS functions to the new server.

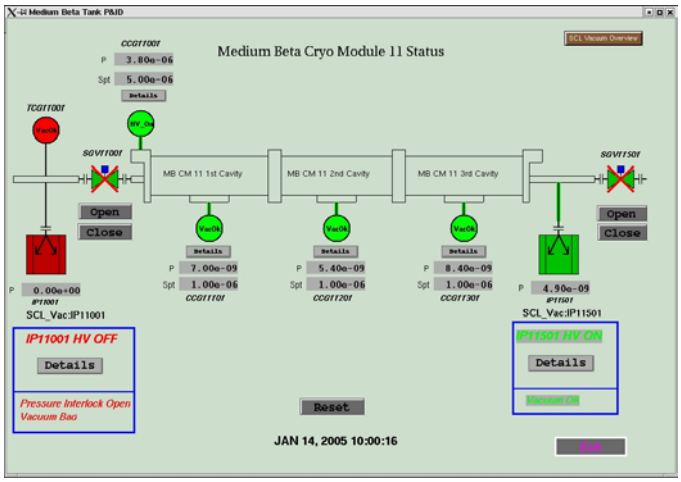
The cryogenic control system performed as needed during the cooldown of several cryomodules. A detailed pre-cool down checklist was prepared and used for cryomodules MB08, MB10, and MB11.

The Conventional Facilities cooling water screens have been upgraded to include the 4th chiller/condenser and tower water pump, as well as more explanatory text.

The last two SROs for installation of ICS communications cables in the Klystron Building were turned over to the Installation Group this week. All SROs for FE through HEBT have now been submitted. ICS communications cable design for the Ring is now in the "final check" stage and should be completed next week. We are now starting installation design for ICS communications cables in the Target Building.

Support for three new Beckhoff I/O modules was added to the new driver infrastructure. The ease with which this was accomplished (two hours for all three) demonstrates the modularity and expandability of the new driver architecture. The new driver was implemented and is running on SCL_HPRF:IOC09.

The SCL vacuum control Zone 3 (MB09-11) has been signed off for RF conditioning – the archive is configured and the screens verified. A sample screen is shown below.



Installation

Craft Snapshot 1/4/05

ASD productive craft workers	**72.0**
Foremen (Pd by 15% OH)	6.0
AMSI management (Pd directly)	3.0
TOTAL AMSI WORKERS	81.0
Less WBS 1.9, 1.2 etc	**8.0**
Less absent	**3.0**
TOTAL PD BY ASD/ORNL DB WPs	**61.0**

Accelerator Physics

Work continues on radiation model calculations for the end of the RTBT beam line. Irina Popova is scheduled to present a status report to the Radiation Working Group on Wednesday, Jan. 19.

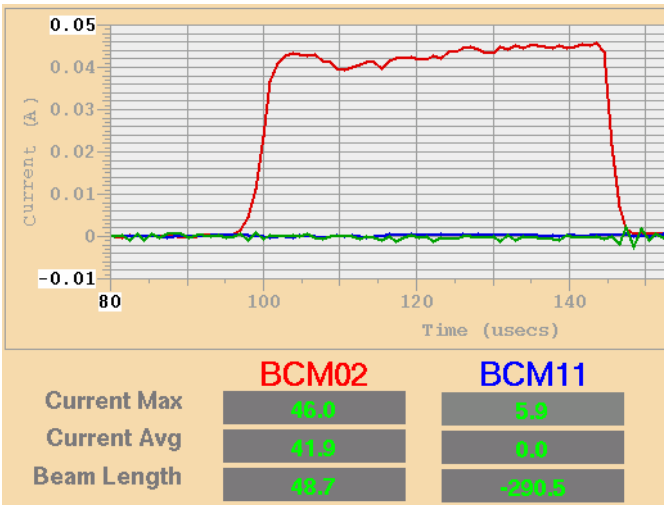
The LEBT chopper produced its first minipulse this week. Congratulations to the chopper team.

Updated global coordinates for the Linac, Ring and RTBT are now being prepared. An official document will be released soon.

Operations

Ion Source

Less than 24 hours after deciding that a new ion source was needed, ion source #4 delivers record MEBT currents. This is the shortest time span, in which an SNS ion source reached the nominal beam current. Future startups are expected to be even faster.



The output of ion source #2, installed on 12-18-04, delivered only 36 mA after its 3rd cesiation (25 minutes at 570 C) and lost about 2 mA per day. The 4th cesiation on 1-12-05 (25 minutes at 600 C) failed to increase the output. When this became obvious around 10 pm, it was decided to install a new source. Syd Murray replaced the source around midnight. Around 9:30 am a new, accelerated conditioning procedure was initiated. After replacing a broken oscilloscope, the 1st cesiation (25 minutes at 530 C) produced ~30 mA. A 2nd cesiation was performed (15 minutes at 540 C). While the output was rising, it had to be reduced to produce 20 mA for the laser wire experiments. At 7 pm, a cooling water fault shut down the entire ion source and LEBT. The source was restarted and tuned for high output before it was reduced to the 38 mA required for the next experiment.

Survey and Alignment

Mechanical

Water Systems Installation

- A DI water makeup system was installed to the FEB chiller room.
- Installation of the HEBT tunnel cooling to the magnets was completed to the ground break.
- The HEBT tunnel magnet cooling has been running successfully nonstop for over a week.
- Installation of the RING SB power supply cooling system manifolds continued.
- Installation of the RING SB PFN cooling system manifolds continued.
- Installation of the SCL Cryo Warm Section Magnet cooling connections continued.
- Installation of the SCL ME06 HVCM and SCR cooling system continued.
- Maintenance activities included cleaning of filters and adjustment of pressure regulators

Ring Systems Installation

- The Ring Injection straight section downstream Doublet Magnet assy was installed.
- The Ring Injection straight section upstream Doublet Magnet assy installation was started.
- The Ring RF straight section upstream Doublet Magnet assy was received and staged for installation.
- The Ring RF Cavity #4 was installed.
- The RTBT 21Q40 magnet stands were installed.
- An integration meeting was held with XFD on the installation and startup of the Ring Injection Dump and associated cooling systems.
- An integration meeting was held with the PPS group to initiate the design of the PPS gates in the RING tunnel

Magnet Task

Electrical Group

Power Supplies:

- Completed integrated magnet/power supply/controls testing for SCL warm sections MB-5 and MB-8, bringing the completed warm section integrated magnet/power supply/controls tests to 4 of 34. Started integrated magnet/power supply/controls testing on warm section MB-7.
- Started integrated magnet/power supply/controls testing on HEBT power supplies.

Electrical Installation:

- Linac Tunnel – Cable terminations for SCL module HB-5 and HB-6, warm section terminations
- SCL ME-5 area – diagnostics, controls and vacuum terminations in progress
- SCL ME-6 area – cable pulling and ac power installation in progress
- SCL ME-7 area – cable tray and ground plane installation in progress
- SCL ME-8 area – ac power terminations in progress
- Ring – ac power terminations for rf systems, PPS wiring, and tray installation for diagnostics room in progress.
- CLO Control Room – terminations in progress

On DTL-ME2, we installed an additional terminator to reduce the signal level, recalibrated the PLC (so as to give the correct current readback through EPICS), and adjusted the over current threshold to overcome a faulty overcurrent trip condition. These are temporary fixes to get us through this operation period and will need to be permanently fixed at the completion of operations. SCL-ME5 (now SCL Mod 15) has nearly completed checkout, lacking only peak power and crowbar tests. SCL-ME6 now is partially installed and water interfaces have been started. The LEBT choppers were used successfully this week, and testing with the MEBT chopper is slated to begin over the weekend.

HPRF

Ring RF

- Completed a Ground Plane layout for the Ring RF System including the RF Control Room.
- Worked on AC power connection drawings.
- Worked on integrating equipment names as defined by Brookhaven into SNS standards.
- Updated the Ring Service Building RF Rack names.

LLRF

Cryo Group

From JLab:

- H10 has been received at SNS
- H11 will be here within two weeks
- H12 cavity string is in the space frame
- H2 string is out of the cleanroom and into the cryomodule assembly area

At SNS:

Earlier this week tests were conducted to verify the appropriate cleaning, assembly, installation and connection to cryomodules of the warm sections of the SNS superconducting linac. The tests were conducted according to the following logic:

- The most likely form of contamination is due to particulates
- The effect of particulates is to lower the threshold of field emission and to increase the associated radiation levels

- Qo is not an accurate measurement of cavity degradation and requires cumbersome and lengthy measurements, especially in installed cavities operated in pulse mode.
- The threshold of field emission onset is the most accurate measurement of the effects of contamination and a precursor of any Qo degradation

The tests were conducted on two different warm sections connecting three different cryomodules, by monitoring the radiation threshold before, during and after the opening of gate valves (one at a time) connecting warm sections to cryomodules.
The radiation generated by field-emitted electrons was monitored orthogonally to the beamline using an ion chamber outside the cryomodule next to the cell nearest to the gate valve being opened.
Of the presently cold four cryomodules, three had had the outboard gate valves replaced by JLab personnel in the SNS tunnel, due to known contamination by lubricants in the gate valves themselves.
Only one warm section side was facing a cryomodule that had not had that gate valve replacement. That valve (facing the first cavity in cryomodule position #6) was the first to be opened, so that there would be no question that any cavity performance degradation would come from the warm section and not from the potentially contaminated valve assembly.
The RF was pulsed at 10 pulses per second, with a short pulse (350 microseconds), so that the detection of the threshold would correspond to the peak field reached and not obscured by average effects. The incident power was as high as 250 kW peak. During the course of the measurements, with gate valves closed or opened, some net increase of the threshold was observed in all four cavities to various degrees, thanks to the pulse processing. The cavities were operated at 4.2 K.
The results are as following:
Cavity 6a (gate valve not replaced in tunnel) showed a field emission threshold at about 13.5 MV/m, which slowly increased to 14 MV/m with the gate valve opened over the course of about half an hour.
Cavity 5c (opposing end of the same warm section and with valve replaced in tunnel): threshold at 10.4 MV/m. Unchanged after opening valve.
Cavity 5a (gate valve replaced) had threshold at 9 MV/m, increased to 9.4 MV/m after valve opening.
Cavity 4c (gate valve replaced) had threshold at 10.9 MV/m without any change of radiation level after valve opening.
Since all the measurements were done in real time, the actual absolute calibration of the fields was not a factor.
This test confirms that the procedures developed for cleaning, assembling, installing and attaching warm section to cryomodules are sound and that they are carried out correctly and proficiently.

Presently 6 medium beta cryomodules are cold, 4 of them tested

Cryomodule testing: Nightly operation of the available cryomodules is continuing to determine operability of the systems.

Beam Diagnostics